

REMARKS

Claims 1, 4, 5 and 7 have been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicants regard as their invention. The applicants respectfully submit that no new matter has been added. It is believed that this Amendment is fully responsive to the Office Action dated **July 9, 2004**.

Claim Rejections under 35 USC §102

Claims 1-3, 7 and 8 are rejected under 35 USC §102(b) as anticipated by or, in the alternative, under 35 USC §103(a) as obvious over Shibuya (U.S. Patent No. 4,516,920).

The present invention is an expander (6) used in a refrigeration cycle using carbon dioxide as the refrigerant. The present invention also includes a compressor (1), an outdoor heat exchanger (3) and an indoor heat exchanger (8). The expander (6) includes a cylindrical cylinder (61) and a rotor (62) that rotates in the cylinder (61). The rotor (62) includes a number of vane grooves (68) and vanes (69) slidably disposed in the vane grooves (68). The vanes (69) divides an expansion space which is formed between an inner peripheral surface of the cylinder (61) and an outer peripheral surface of the rotor (62). The vane grooves (68) are provided with back pressure chambers (68a) which push the vanes (69) against the inner peripheral surface of the cylinder (61). Carbon dioxide refrigerant in a supercritical state is introduced into the back pressure chambers (68a).

Shibuya describes a variable capacity vane compressor (1) capable of controlling back pressure acting on vanes (10). The vane compressor (1) includes a front head (2), a casing (3) secured to the front head (2) and a cylinder (4) disposed within the casing (3). A rotor (8) is provided within the pump housing. The rotor (8) has its outer peripheral surface formed therein with four slits (8a) circumferentially arranged at equal intervals with vanes (10) slidably fitted in their respective slits (8a). The rotor (8) has its interior formed with axially extending back pressure chambers (14) communicating with radially inner ends of their respective slits (8a).

Independent claims 1 and 7 have been amended to include all the features of claim 6. The Examiner indicated that claim 6 contained allowable subject matter. Specifically independent claims 1 and 7 have been amended to include that “the expander is lubricated by oil mist discharged from the compressor”. The prior art of record fails to disclose this feature.

Therefore, amended claims 1 and 7 patentably distinguish over the prior art relied upon by reciting, as exemplified by claim 1,

“An expander used in a refrigeration cycle using carbon dioxide as refrigerant and having a compressor, an outdoor heat exchanger and an indoor heat exchanger, wherein said expander comprises a cylindrical cylinder, a rotor which rotates in said cylinder, a vane which divides an expansion space formed between an inner peripheral surface of said cylinder and an outer peripheral surface of said rotor into a plurality of spaces, and a vane groove provided in said rotor for accommodating said vane therein, and wherein said vane groove is provided with a back pressure chamber which pushes said vane against the inner peripheral surface of said cylinder, and said refrigerant in the supercritical state is introduced into said back pressure chamber, wherein the expander is lubricated by oil mist discharged from the compressor.” (Emphasis Added)

Therefore, withdrawal of the rejection of Claims 1-3, 7 and 8 under 35 USC §102(b) as anticipated by or, in the alternative, under 35 USC §103(a) as obvious over Shibuya (U.S. Patent No. 4,516,920) is respectfully requested.

Claims 1-3 are rejected under 35 USC §102(b) as anticipated by or, in the alternative, under 35 USC §103(a) as obvious over DE2544232.

DE2544232, shows in Figure 1, an expansion engine having a rotor (10), a cylinder body (12) and vanes (16). Back pressure chambers (14) appear to be provided in the figure.

As previously discussed, independent claim 1 has been amended to include all the features of claim 6. The Examiner indicated that claim 6 contained allowable subject matter. Specifically, independent claim 1 has been amended to include that “the expander is lubricated by oil mist discharged from the compressor”. The prior art of record fails to disclose this feature.

Claim Rejections under 35 USC §103

Claims 4 and 5 are rejected under 35 USC §103(a) as being unpatentable over Ishida (JP 2001-066006) in view of Shibuya (U.S. Patent No. 4,516,92) and further in view of Karl (U.S. Patent No. 6,178,761).

Ishida describes a refrigerant circuit for an air conditioner having a compressor (3) and an expander (4). Two four way valves (11 and 12) are shown as provided in figures 1 and 2.

Karl describes in the abstract that the refrigerant is carbon dioxide compressed by the compressor to a supercritical pressure.

Claims 4 and 5 have been amended to include the feature that the expander is lubricated by oil mist discharged from the compressor. This feature was included in claim 6. The Examiner indicated that claim 6 contained allowable subject matter.

Therefore, independent claims 4 and 5 patentably distinguish over the prior art relied upon by reciting, and exemplified by claim 4,

“A refrigeration cycle apparatus having a refrigeration cycle using carbon dioxide as refrigerant and having a compressor, an outdoor heat exchanger, an expander and an indoor heat exchanger, said refrigeration cycle apparatus including, in said refrigeration cycle, a first four-way valve to which a discharge side pipe and a suction side pipe of said compressor are connected, and a second four-way valve to which a refrigerant-inflow side pipe and a refrigerant-outflow side pipe of said expander are connected, wherein using, as said expander, a sliding vane type expander having a cylindrical cylinder, a rotor which rotates in said cylinder, a vane which divides an expansion space formed between an inner peripheral surface of said cylinder and an outer peripheral surface of said rotor into a plurality of spaces, and a vane groove provided in said rotor for accommodating said vane therein, refrigerant flowing through a pipe extending from said second four-way valve to a refrigerant-inflow port of said expander is introduced into a back surface of said vane, wherein the expander is lubricated by oil mist discharged from the compressor.” (Emphasis Added)

Therefore, withdrawal of the rejection of Claims 4 and 5 under 35 USC §103(a) as being unpatentable over Ishida (JP 2001-066006) in view of Shibuya (U.S. Patent No. 4,516,92) and further in view of Karl (U.S. Patent No. 6,178,761) is respectfully requested.

Claims 4 and 5 are rejected under 35 USC §103(a) as being unpatentable over DE2544232 as applied to claims 1-3 above, and further in view of Shibaura Electric Co. (JP 62-77562).

As previously discussed, independent claims 4 and 5 have been amended to include all the features of claim 6. The Examiner indicated that claim 6 contained allowable subject matter. Specifically independent claims 1 and 7 have been amended to include that “the expander is lubricated by oil mist discharged from the compressor”. The prior art of record fails to disclose this feature.

Allowable Subject Matter

Claim 6 is objected to as being dependent upon a rejected base claim. Claim 6 has been canceled, thus rendering this objection moot. All the features of claim 6 have been incorporated into independent claims 1, 4, 5 and 7. Therefore, independent claims 1, 4, 5 and 7 are in condition for allowance.

Conclusion

In view of the aforementioned amendments and accompanying remarks, claims 1, 4, 5 and 7, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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